Data Paper

Shun Tsutaki, Kotaro Fukui, Hideaki Motoyama, Akihisa Hattori, Jun'ichi Okuno, Shuji Fujita and Kenji Kawamura.. Surface heights over a traverse route from S16 to Dome Fuji, East Antarctica as measured by kinematic GNSS surveys in 2012–2013 and 2018–2019. Polar Data Journal. 2021, 5, p.144–156. https://doi.org/10.20575/00000033.

(Received 8/24/2021; Accepted 11/4/2021)

1st submission

Editor Start Date: 8/30/2021

Editor Stop Date: 9/28/2021

Reviewer #1 (8/30/2021–9/27/2021)

Reviewer #2 (8/31/2021–9/28/2021)

Editor comments to the Author: Naohiko Hirasawa

Dear Authors,

Thank you for submitting to PDJ this time.

It was peer-reviewed by two reviewers. Both of them value this as worth publishing. One rated it as "minor revision" and the other as "major revision" with some questions as shown below. Since all of them are minor comments, my overall evaluation is "minor revision". I would like the authors to send back a revised manuscript and some explanation. The revised manuscript will be reviewed by the reviewers again.

Sincerely

Naohiko Hirasawa

Reviewer #1: Anonymous

This paper describes surface height data from the Kinematic global navigation satellite system (JARE) over two summers in the southern hemisphere.

The data are tabulated in CSV format for each region, and the vertical and horizontal standard deviations are discussed.

The data were confirmed as described, so there is no problem.

The text is sometimes difficult to read, so it should be sent to an English reviser once.

The following is a list of comments on areas that should be corrected or reviewed.

Figure 1. (c) The text added to the photo is not readable in the PDF version because it overlaps with the black area.

Table 1: What is CDV in the caption?

L127: Although it is a standard GNSS data format, it is better to include the official name of RINEX.

L136: Why do you use "stdu" as the standard deviation of height? I don't understand why "u" is used. Shouldn't "SD" be the abbreviation for standard deviation? Please consider about other abbreviations for "std-".

Reviewer #2: Anonymous

Review of "Surface heights over a traverse route from S16 to Dome Fuji, East Antarctica as measured by kinematic GNSS surveys in 2012-2013 and 2018-2019" by Shun TSUTAKI et al. Polar Data Journal: PDJ-D-21-00007

General comments:

In this data paper, the authors present surface height data, which is obtained from kinematic global navigation satellite system (GNSS) measurements performed by the authors, over an inland traverse route in the East Antarctic ice sheet. The dataset is certainly valuable for understanding/monitoring the physical conditions of the Antarctic ice sheet, which is expected to change drastically in the near future due to the ongoing global warming. In addition, this reviewer has found that the data acquisition processes by the authors is reliable. Therefore, this reviewer recommends its publication; however, this reviewer suggests that there are some points that can be improved before publication.

Please find specific comments listed below.

Specific comments:

L. 29: "in the horizontal and vertical directions.": At this stage, the authors' intention especially regarding "the error in the horizontal direction" is a bit unclear to me, although I can understand "the error in the vertical direction". Can the authors explain about "the error in the horizontal direction" a bit more in detail here?

Sect. 1: Please consider indicating briefly why the authors conducted this field measurements. I believe such background story would be informative for readers.

L. 43 ~ 46: As far as I understand, satellite altimetry data cannot provide data for mass changes of an ice sheet directly; Information regarding snow/ice density near the ice sheet surface is necessary to retrieve the mass change data from the satellite altimetry data. If my understanding is correct, please consider indicating this point as another source of error here.

L. 48 ~ 49: A reference for this argument is needed here.

L. 58: "traverse route" -> "traverse routes"? Please check this point again.

L. 66 ~ 70: I cannot fully understand the relationship/connection between these two sentences. Maybe, "has not yet

been published" at the end of this part should be rephrased to something like "had not yet been performed"?

L. 74: "~ height data measured along the ~": "measured" can be removed.

L. 75 ~ 76: "an accuracy of <0.4 m in the horizontal and vertical directions.": In my humble opinion, this explanation is too simple to understand for some readers. More detailed processes to obtain the accuracy should be introduced. If it is related to the explanations in Sect. 5, it should be indicated so here. However, in Sect. 5, please note accuracies of the data only in the vertical direction are indicated.

L. 78: "will be" -> "is"

L. 79: What do the authors mean by "a high degree of accuracy"? Please indicate quantitatively.

L. 80: To me, using "validation" here is too strong, because the error of the data presented in this paper is still not minor in my humble opinion. In general, validation requires (almost) the perfect data as a reference. Therefore, I suggest using "evaluation" instead of "validation" here.

L. 86: Suggest adding "a.s.l." after surface elevation values like 589 m a.s.l.

L. 90: The definition of "NDF" is needed here.

L. 120 ~ 121: "sampling rate" -> "sampling interval"?

L. 127: Some readers may not be familiar with the "RINEX" data format. Please consider explaining the data format briefly here.

L. 130 ~ 131: It will be nice if the authors indicate briefly what kind of analyses can generally be done with RTKLIB here.

L. 131 ~ 132: What do the authors mean by "L1 and L2 frequency data"?

L. 167 ~ 168: "The standard deviations" of what?

L. 167 ~ 169: It is informative to indicate why the order of the standard deviations for the 54th and 60th expeditions is obviously different (one order higher in the 60th expedition).

Figure 4 caption: "Surface height and the accuracy of GNSS measurements in the vertical direction" - > "Surface height (red line) and the accuracy of GNSS measurements in the vertical direction (blue line)"

Figures 2 ~ 4: Do the authors mean "accuracy" shown in these figures is accuracy of the data in the "vertical" direction? Please clarify in the captions.

Authors Response:

Dear Editor,

Thank you very much for careful evaluation of our manuscript. We also thank the two reviewers for thoughtful and useful comments to improve the manuscript. In the following, we describe our responses (in red) point-by-point to each referee comment (in black).

Response to reviewer #1;

This paper describes surface height data from the Kinematic global navigation satellite system (JARE) over two summers in the southern hemisphere.

The data are tabulated in CSV format for each region, and the vertical and horizontal standard deviations are discussed.

The data were confirmed as described, so there is no problem.

1. The text is sometimes difficult to read, so it should be sent to an English reviser once.

A native English speaker has edited the original manuscript. A native check letter was attached after the response letter.

2. The following is a list of comments on areas that should be corrected or reviewed.

We would like to thank the reviewer for positive evaluation and helpful comments.

3. Figure 1. (c) The text added to the photo is not readable in the PDF version because it overlaps with the black area.

The black area outside the photo was probably due to transparency caused by a PNG image. We have changed it to a JPEG image.

4. Table 1: What is CDV in the caption?

“CDV” was a misnomer for “CSV” file format. We have changed it to CSV.

5. L127: Although it is a standard GNSS data format, it is better to include the official name of RINEX.

The official name of RINEX (Receiver Independent Exchange Format) has been added. (line 132)

6. L136: Why do you use "stdu" as the standard deviation of height? I don't understand why "u" is used. Shouldn't "SD" be the abbreviation for standard deviation? Please consider about other abbreviations for "std-".

We have changed the abbreviation for each standard deviation in the data file as “SD-N” (-North), “SD-E” (-East), “SD-V” (-Vertical), “SD-NE” (-North & East), “SD-EV” (-East &Vertical), “SD-VN” (-Vertical & North).

Reponse to reviewer #2;

Review of "Surface heights over a traverse route from S16 to Dome Fuji, East Antarctica as measured by kinematic GNSS surveys in 2012-2013 and 2018-2019" by Shun TSUTAKI et al. Polar Data Journal: PDJ-D-21-00007

General comments:

1. In this data paper, the authors present surface height data, which is obtained from kinematic global navigation satellite system (GNSS) measurements performed by the authors, over an inland traverse route in the East Antarctic ice sheet. The dataset is certainly valuable for understanding/monitoring the physical conditions of the Antarctic ice sheet, which is expected to change drastically in the near future due to the ongoing global warming. In addition, this reviewer has found that the data acquisition processes by the authors is reliable. Therefore, this reviewer recommends its publication; however, this reviewer suggests that there are some points that can be improved before publication.

Please find specific comments listed below.

We would like to thank the reviewer for positive evaluation and helpful comments.

Specific comments:

2. L. 29: "in the horizontal and vertical directions.": At this stage, the authors' intention especially regarding "the error in the horizontal direction" is a bit unclear to me, although I can understand "the error in the vertical direction". Can the authors explain about "the error in the horizontal direction" a bit more in detail here?

The accuracy of the data in the horizontal direction was estimated by quadratic sum of the absolute standard deviations of north, east and north-east component (SD-N, SD-E and SDNE). The standard deviations of north-east component (SD-NE) were estimated by square root of the absolute value of east and north components of the estimated covariance matrix. The sign of the SD-NE represents the sign of the covariance. We have added an explanation about how to estimate the horizontal accuracy of the data in the main text (Section 4 “Data Records” in lines 167-171, and Section 5 “Technical Validation” in line 179).

3. Sect. 1: Please consider indicating briefly why the authors conducted this field measurements. I believe such background story would be informative for readers.

We thank the reviewer for this suggestion. We have added our reasons for planning these surveys as follows.

“The precise observations of the surface topography by in-situ GNSS are essential for constraining the dynamics of glaciers and the surface mass balance.” (lines 73-74).

4. L. 43 ~ 46: As far as I understand, satellite altimetry data cannot provide data for mass changes of an ice sheet directly; Information regarding snow/ice density near the ice sheet surface is necessary to retrieve the mass change data from the satellite altimetry data. If my understanding is correct, please consider indicating this point as another source of error here.

We have added this point in the main text (lines 46-47).

5. L. 48 ~ 49: A reference for this argument is needed here.

We have added a reference of Kohler et al. (2013) and listed in the References. (line 51 and 4th in Reference)

Kohler, J., et al. ICESat Elevations in Antarctica Along the 2007–09 Norway–USA Traverse: Validation With Ground-Based GPS. IEEE Transactions on Geoscience and Remote Sensing. 2013, 51 (3), p.1578–1587. https://doi.org/10.1109/TGRS.2012.2207963.

6. L. 58: "traverse route" -> "traverse routes"? Please check this point again.

This has been corrected. (line 57)

7. L. 66 ~ 70: I cannot fully understand the relationship/connection between these two sentences. Maybe, "has not yet been published" at the end of this part should be rephrased to something like "had not yet been performed"?

We have changed this part as “has not yet been performed” (line 72). As described in reply to comment from the reviewer 2 (see comment 3), we have also added our reasons for planning these surveys to clarify the relationship/connection with the immediately preceding paragraph (lines 73-74).

8. L. 74: "~ height data measured along the ~": "measured" can be removed.

This has been corrected. (line 77)

9. L. 75 ~ 76: "an accuracy of <0.4 m in the horizontal and vertical directions.": In my humble opinion, this explanation is too simple to understand for some readers. More detailed processes to obtain the accuracy should be introduced. If it is related to the explanations in Sect. 5, it should be indicated so here. However, in Sect. 5, please note accuracies of the data only in the vertical direction are indicated.

We have changed this sentence as follows to indicate more detailed process to estimate the accuracy in the vertical direction.

“GNSS coordinates obtained at a sampling interval of 1 sec were post-processed in precise point positioning (PPP) kinematic mode. An accuracy of <0.4 m in the vertical direction was estimated from the standard deviations of the solutions.” (lines 78-80)

We have also deleted the description of horizontal accuracy in this section and the abstract.

10. L. 78: "will be" -> "is"

This has been corrected. (line 83)

11. L. 79: What do the authors mean by "a high degree of accuracy"? Please indicate quantitatively.

We have added an example of the accuracy as “(i.e., <0.5 m)”. (line 84)

12. L. 80: To me, using "validation" here is too strong, because the error of the data presented in this paper is still not minor in my humble opinion. In general, validation requires (almost) the perfect data as a reference. Therefore, I suggest using "evaluation" instead of "validation" here.

We have changed to “evaluation” as the reviewer suggested. (line 85)

13. L. 86: Suggest adding "a.s.l." after surface elevation values like 589 m a.s.l.

An elevation of S16 (589 m) was measured in the ellipsoid height. We have changed the description as “ (..., 589 m: ellipsoid height)” (line 90)

14. L. 90: The definition of "NDF" is needed here.

We have changed the definition of NDF as “New Dome Fuji (NDF)”. (lines 95-96)

15. L. 120 ~ 121: "sampling rate" -> "sampling interval"?

This has been corrected. (line 126)

16. L. 127: Some readers may not be familiar with the "RINEX" data format. Please consider explaining the data format briefly here.

We have added the official name of RINEX as described in the reply to comments from the reviewer 1 (see the reply

to comment 4).

17. L. 130 ~ 131: It will be nice if the authors indicate briefly what kind of analyses can generally be done with RTKLIB here.

We have added a brief explanation of RTKLIB as follows.

“RTKLIB is an open-source program package for standard and precise positioning algorithms with GNSS, allowing us for processing GNSS data with static and kinematic modes.” (lines 135-137)

18. L. 131 ~ 132: What do the authors mean by "L1 and L2 frequency data"?

L1 and L2 frequencies are observation data using dual-frequency bands unique to each GNSS satellite, which provides more information than observations using a single-frequency band, reducing the observation time required. We have changed this part more clarify as “L1 and L2 dual-frequency measurements”. (line 138)

19. L. 167 ~ 168: "The standard deviations" of what?

This meant “The standard deviations of the estimated position”. We have changed this part more clarify as follows.

“The standard deviations of the estimated position for the 54th and the 60th expeditions were 0.02 m and 0.18 m in the horizontal direction (quadratic sum of SD-N, SD-E and SD-NE) and 0.03 m and 0.16 m in the vertical direction (SD-V), respectively.” (lines 177-180)

20. L. 167 ~ 169: It is informative to indicate why the order of the standard deviations for the 54th and 60th expeditions is obviously different (one order higher in the 60th expedition).

We thank the reviewer for this suggestion. We have added a presumable reason that the standard deviations of the data for the 60th JARE were one-order larger than those of the 54th expedition as follows.

“Note that the standard deviation of the 60th expedition is one order larger than that of the 54th. Presumably, the power supply of the mobile battery is sometimes less than the required power consumption of the GNSS receiver, and thus the observation and recording become intermittent.” (lines 180-183)

21. Figure 4 caption: "Surface height and the accuracy of GNSS measurements in the vertical direction" - > "Surface height (red line) and the accuracy of GNSS measurements in the vertical direction (blue line)"

This has been corrected.

22. Figures 2 ~ 4: Do the authors mean "accuracy" shown in these figures is accuracy of the data in the "vertical" direction? Please clarify in the captions.

“The accuracy” meant the accuracy in the vertical direction (σz) estimated at lines 189-191 in the main text. We have changed this explanation in the captions of Figures 2 and 3 as follows.

“The accuracy of the kinematic GNSS measurements in the vertical direction (σz) along the survey routes... “.

We have also changed the caption of Figure 4 as follows.

“Surface height (red line) and the accuracy of GNSS measurements in the vertical direction (σz, blue line) along the surveyed route... ”.

Other changes

1. We have changed the Section 2 as “Study area”, and re-numbered sections of “Figures” and “Tables” as “6” and “7”, respectively.

2. We have changed from “Elevation (m)” to “Surface height (m)” in Figures 2-4 to be consistent with the captions of these figures and related descriptions in the main text.

3. In “Acknowledgements”, we have changed descriptions of JSPS KAKENHI Grant Numbers in accordance with the JSPS's acknowledgement format.

4. Data file: We have changed the header section as follows:

/data_made: >> 20211010

/data_file_name: removed “GNSS_surfZ_”

/data_type: point >> line (According to the judgment of the ADS office)

2nd submission

Editor Start Date: 10/11/2021

Editor Stop Date: 10/30/2021

Reviewer #1 (10/13/2021–10/29/2021)

Reviewer #2 (10/11/2021–10/11/2021)

Editor Comments to the Author: Naohiko Hirasawa

Dear Dr. Tsutaki,

Thank you for sending the revised manuscript. The reviewer #2 evaluated it as acceptable as it is. However, I agree with a comment from the reviewer #1, that is, for potential users who are unaware of kinematic GNSS, I would like you to add a brief explanation of the kinematic GNSS to the introduction before publishing this paper. I will make a proposal for acceptance after this is completed. Thank you very much.

Naohiko Hirasawa

Reviewer #1: Anonymous

The revised paper seems to be more reader-friendly. However, I feel that the introduction, including the abstract, is difficult to understand. After reading the paper many times, I have come to the conclusion that this is due to the lack of basic explanation about GNSS. I have never heard of GNSS before, and I am reviewing this paper without knowing anything about its theory. I think that it is difficult for readers to understand the history of various observations made with GNSS when they do not understand GNSS itself. Therefore, a brief explanation of GNSS and the methods of Kinematic GNSS should be included for the introduction. The rest of the document does not need to be revised.

Reviewer #2: Anonymous

General comments: The authors' responses to both referees' earlier concerns are convincing, and the manuscript has been improved greatly. I would like to thank the authors for considering my comments and suggestions. Now, the paper describes the data in detail and accurately. Therefore, this reviewer recommends its publication.

Authors Response:

Dear Editor,

Thank you very much for careful evaluation of our manuscript. We also thank the two reviewers for thoughtful and useful comments to improve the manuscript. In the following, we describe our responses (in red) to each referee comment (in black).

Response to reviewer #1;

The revised paper seems to be more reader-friendly. However, I feel that the introduction, including the abstract, is difficult to understand. After reading the paper many times, I have come to the conclusion that this is due to the lack of basic explanation about GNSS. I have never heard of GNSS before, and I am reviewing this paper without knowing anything about its theory. I think that it is difficult for readers to understand the history of various observations made with GNSS when they do not understand GNSS itself. Therefore, a brief explanation of GNSS and the methods of Kinematic GNSS should be included for the introduction. The rest of the document does not need to be revised.

We would like to thank the reviewer for valuable suggestion. We have added an explanation of GNSS and the kinematic PPP method in the Introduction as follows:

“GNSS is a navigation system that determines the position of a receiver by receiving radio signals from multiple satellites (such as GPS, GLONASS etc.). The Kinematic Precise Point Positioning (Kinematic PPP) method determines

the position of a receiver with high accuracy by post-processing using satellite ephemeris and clock.” (lines at 50-53)

Response to reviewer #2;

General comments: The authors' responses to both referees' earlier concerns are convincing, and the manuscript has been improved greatly. I would like to thank the authors for considering my comments and suggestions. Now, the paper describes the data in detail and accurately. Therefore, this reviewer recommends its publication.

We would like to thank the reviewer for carefully evaluating our manuscript in the second peer review. We are pleased to hear the reviewers' recommendation that our manuscript will be accepted for publication.

Editorial Office’s note

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